# The response of the European Commission to FCC IB Docket No. 17-16 on provisioning of a waiver for the use of Galileo in the United States

## Introduction

The Galileo programme is funded and owned by the EU and it is the European Commission that has overall responsibility for the programme, managing and overseeing the implementation of all activities on behalf of the EU.

The European Commission welcomes the opportunity to provide comments on the FCC Public Notice (PN) reference DA 17-18 concerning a request from the European Commission for the FCC to grant a waiver so that "non-Federal receive-only earth stations within the United states [can] operate with signals of the Galileo Radionavigation-Satellite Service (RNSS) system.

## Comments

***"We seek comment on the signal characteristics of the Galileo system, which implicates technical, operational, and policy considerations related to the international and U.S. spectrum allocations, including non-Federal allocations"***

The Galileo system operates in accordance with the rules defined in the International Radio Regulations, utilizing allocations identified for RNSS. The particular signal modulations chosen for each band were selected to both minimize interference with other radio systems and other RNSS systems, and also to maximize achievable performance and compatibility with the same RNSS systems.

For the E1 signal, the signal is intended to occupy a bandwidth of 32 MHz. Unofficial sources indicate a signal bandwidth of 40 MHz based upon an unfiltered modulation bandwidth, but these are not system reference sources and so the 32MHz bandwidth indicated in the associated ITU satellite filings for Galileo applies. However, receiver manufacturers may choose to implement wider front end filters in order maximize capture of information contained in the frequency side-lobes, which helps provide the best performance in some precision applications. Like all radio systems brick wall filtering is not possible and the European Commission recognizes that a small amount of signal energy will enter the adjacent band below 1559 MHz. Galileo has transmitted its wideband E1 Public Regulated Service signal in the 1559-1591MHz range since 2006 without reports of interference to systems operating in the band below 1559MHz. The European Commission agrees that Galileo users should not seek to claim protection for reception of signal energies outside of the RNSS allocation from adjacent band systems operating in accordance with the international Radio Regulations.

For the E5 signal, it operates entirely within RNSS allocations and within the specified power limits and operating conditions defined by Resolution 609 of the World Radiocommunication Conference 2003 (mod WRC-07) for the 1164-1215MHz band. This is to ensure that RNSS systems are compatible with, and therefore protect, Distance Measuring Equipment (DME) used by the aeronautical radionavigation service (ARNS), which RNSS systems recognize as an incumbent user. Although transmitted as a single emission, each half of the E5 AltBOC signal can be decoded and processed individually or as a whole. For this reason three centre frequencies (1176.450 MHz, 1191.795 MHz and 1207.140 MHz) are listed depending on how much of the E5 signal is processed.

The E6 signal operates within the 1260-1300 MHz band and conforms to the requirements of the international Radio Regulations.

The most recent ITU satellite filings for the Galileo system specify higher powers for the E1 and E6 signals; these have been successfully coordinated with other RNSS systems that use the same frequency ranges, including GPS.

## Potential Impact relating to Galileo Satellite Signals and non-Federal Receivers Operating with Various Services

### E1 Signal

***"We seek comment on whether E1 transmissions raise any interference or other concerns with respect to non-Federal RNSS, ARNS, and Mobile Satellite Service (MSS) receiver operations."***

and

***"We also seek comment on whether the Galileo E1 signal transmissions raise any interference concerns with respect to any other non-Federal services authorized to operate in adjacent or nearby bands"***

The European Commission considers that Galileo signals are compatible with the other services operating in the same and adjacent bands. Galileo E1 signals have been transmitted since 2006 without reports of interference to receivers of other radio services in adjacent bands.

### E5 Signal

***"We seek comment on whether E5 transmissions raise any interference or other concerns with respect to non-Federal receiver operations"***

The Galileo E5 signal is transmitted in conformance with the obligations required under WRC Resolution 609 and is therefore fully compatible with ARNS systems using the band 1164-1215 MHz.

***"We seek comment on any potential impact from the Galileo E5 signal to non-Federal operations with the GPS L2 signal. In addition, we seek comment on the potential impact of the Galileo E5 signal to any primary authorized non-Federal services operating below 1164 MHz particularly operations under the ARNS and aeronautical mobile service allocations in the 960-1164 MHz band, as well as any potential impact to secondary EES and SRS allocated above 1215 MHz"***

Very limited E5 signal energy is transmitted in the 1215-1219 MHz band and for this reason no interference effects are expected to be observed by non-federal users of other systems that operate in this band, including GPS.

### E6 Signal

***"We seek comment on whether the E6 signal has the potential to cause interference to primary non-Federal ARNS and secondary EESS and SRS in the 1240-1300 MHz band."***

The European Commission is not aware of interference issues concerning systems using the primary allocated ARNS in the U.S. and Canada, but notes that in the adjacent band where the similar E5 signal is located, RNSS has been determined to be compatible with ARNS. For the secondary EESS and SRS allocation, the European Commission notes that Galileo has already successfully coordinated its E6 signal with at least two EESS systems.

## Potential Impacts relating to Galileo Receivers and Non-Federal Operations

### Operations with the Galileo E1 signal

***"We first seek comment on the potential impact that granting the requested waiver for all non-Federal receivers operating with the Galileo E1 signal could have with respect to non-Federal transmitter operations in the 1559-1610 MHz band."***

Receiver manufacturers have shown that incorporating Galileo reception capabilities into a RNSS receiver provides benefits to users without impacting reception of GPS signals. Non-federal users of RNSS receivers in this band will therefore benefit from the availability and processing of Galileo signals by their receivers, especially as the Galileo E1 signal is designed to be fully interoperable with the GPS civilian signals and radio frequency compatible with the military signals.

***"We next seek comment on the potential impact that granting the requested waiver for all non-Federal receivers to operate with the Galileo E1 signal could have with respect to any non-Federal operations in bands outside of the 1559-1610 MHz RNSS allocation."***

Galileo E1 signals have been transmitted in this band since 2006 without reports of interference to receivers operating in adjacent bands.

### Operations with the E5 and E6 signals

***"We seek comment on the potential impact that granting the requested waiver for all non-Federal receivers to operate with the Galileo E5 signal could have on non-Federal operations in the 1164-1215 MHz or 1215-1240 MHz bands, with the Galileo E6 signal in the 1240-1300 MHz band, or any adjacent or nearby band*****."***

Extensive studies conducted within the ITU fora since before WRC-03 have not determined harmful interference impacts from RNSS systems to other systems sharing the bands or in adjacent bands, with the exception of very long range radars, which are typically used by Federal organisations and which can employ interference mitigation techniques and frequency diversity.

### General comment on operations applicable to all Galileo signals

Regarding the design of the receivers, the European Commission does not define how the Galileo Signal in Space Interface Control Document (that defines the Galileo signal) is implemented. Receiver manufacturers have the freedom to innovate to the maximum extent in order to achieve desired performance levels. This applies to receivers for the E1, E5 and E6 signals.

The Galileo signals were designed to be fully interoperable with the next generation of GPS signals and fully compatible with the current generation GPS C/A and P(Y) code signals, which means even if existing GPS receivers cannot utilize the Galileo signals, they should not suffer degradation.

## Public Interest Benefits and Other Considerations

***"we here seek comment on the public interest benefits that are associated with the Commission's grant of a waiver"***

The availability of reliable and accurate GPS signals has been a huge driver for the world economy and while that will continue, the reliance on a single RNSS system raises concerns about single point failures. With the introduction of alternative global RNSS systems including the EU's Galileo, users can get the assurance that their GPS position, navigation and timing fixes can be effectively backed up by other RNSS systems. And with an increased range of RNSS signals from these other systems, often using frequencies different from GPS, position, navigation and timing can be even more reliable, accurate and resilient.

Use of satellite navigation in dense urban cities with tall buildings blocking the sky view will benefit from the increased availability of satellites to include in receivers' computed position fixes. Galileo has the advantage of being the only other RNSS system that is fully compatible and interoperable with GPS, meaning that in future, user receivers will be able to combine Galileo and GPS satellite signals almost as if they were from the same system. This will help make navigation in cities more accurate, precise and reliable.

By granting a waiver, the FCC will give users confidence that signals from the Galileo system are authorised and can be legally used for their position, navigation and timing applications.